

**blackmer compressors**

**INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS**

**MODELS**

**LB161B  
LB162B**

**LB361B  
LB362C**

**LB601B  
LB602B**

**SAFETY DATA**



This is a SAFETY ALERT SYMBOL. When you see this symbol on the product, or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.



Warns of hazards that WILL cause serious personal injury, death or major property damage.



Warns of hazards that CAN cause serious personal injury, death or major property damage.



Warns of hazards that CAN cause personal injury, or property damage.

**NOTICE**

Indicates special instruction which are very important and must be followed.



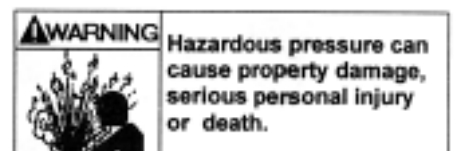
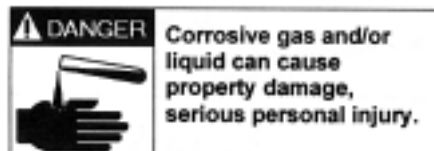
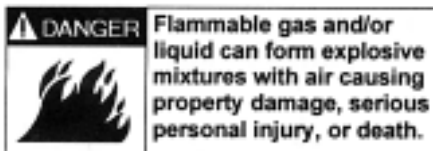
**NOTICE**

Blackmer compressors **MUST** only be installed in systems which have been designed by qualified engineering personnel. The system **MUST** conform to all applicable local and national regulations and safety standards.

These instructions are intended to assist in the installation and operation of Blackmer compressors and **MUST** be kept with the compressor.

Blackmer compressor service and maintenance shall be performed by qualified technicians **ONLY**. Service and maintenance shall conform to all applicable local and national regulations and safety standards.

For handling liquefied gas, it is recommended that NFPA Pamphlet 58 be consulted.



MODEL: ..... ID#:..... SERIAL NO:.....

Before proceeding:

1. Note the nameplate data in the space provided above.
2. Obtain the appropriate parts lists for the model in question.



# GENERAL INFORMATION

## TABLE OF CONTENTS

<b>SAFETY DATA</b> .....	1	<b>MAINTENANCE</b>	
<b>GENERAL INFORMATION</b>		Service Schedule .....	10
Compressor Data .....	3	Tool List .....	11
Nameplate Data .....	4	Bolt Torque Table .....	11
Maximizing Compressor Life .....	5	Crankcase Lubrication .....	12
		Setting the Oil Pressure .....	12
<b>INSTALLATION</b>		<b>COMPRESSOR DISASSEMBLY</b> .....	13
Location and Piping .....	5	<b>COMPRESSOR ASSEMBLY</b> .....	14
Mounting the Compressor Unit .....	6	<b>VALVE REPLACEMENT</b> .....	17
Liquefied Gas Transfer Piping Schematic .....	6	<b>SEAL (PACKING) REPLACEMENT</b> .....	19
Typical Transfer Compressor, Drawing .....	7	<b>BEARING REPLACEMENT</b> .....	20
Relief Valves .....	7	<b>OIL PUMP REPLACEMENT</b> .....	21
4-Way Valves .....	7	<b>EXTENDED STORAGE</b> .....	22
Liquid Traps .....	8	<b>TROUBLESHOOTING</b> .....	23
Temperature and Pressure Switches .....	8	<b>ISO 9000 CERTIFICATE</b> .....	30
Pressure Gauges .....	8		
<b>OPERATION</b>			
Pre-Start up Check List .....	9		
Start Up Procedure .....	9		



## GENERAL INFORMATION

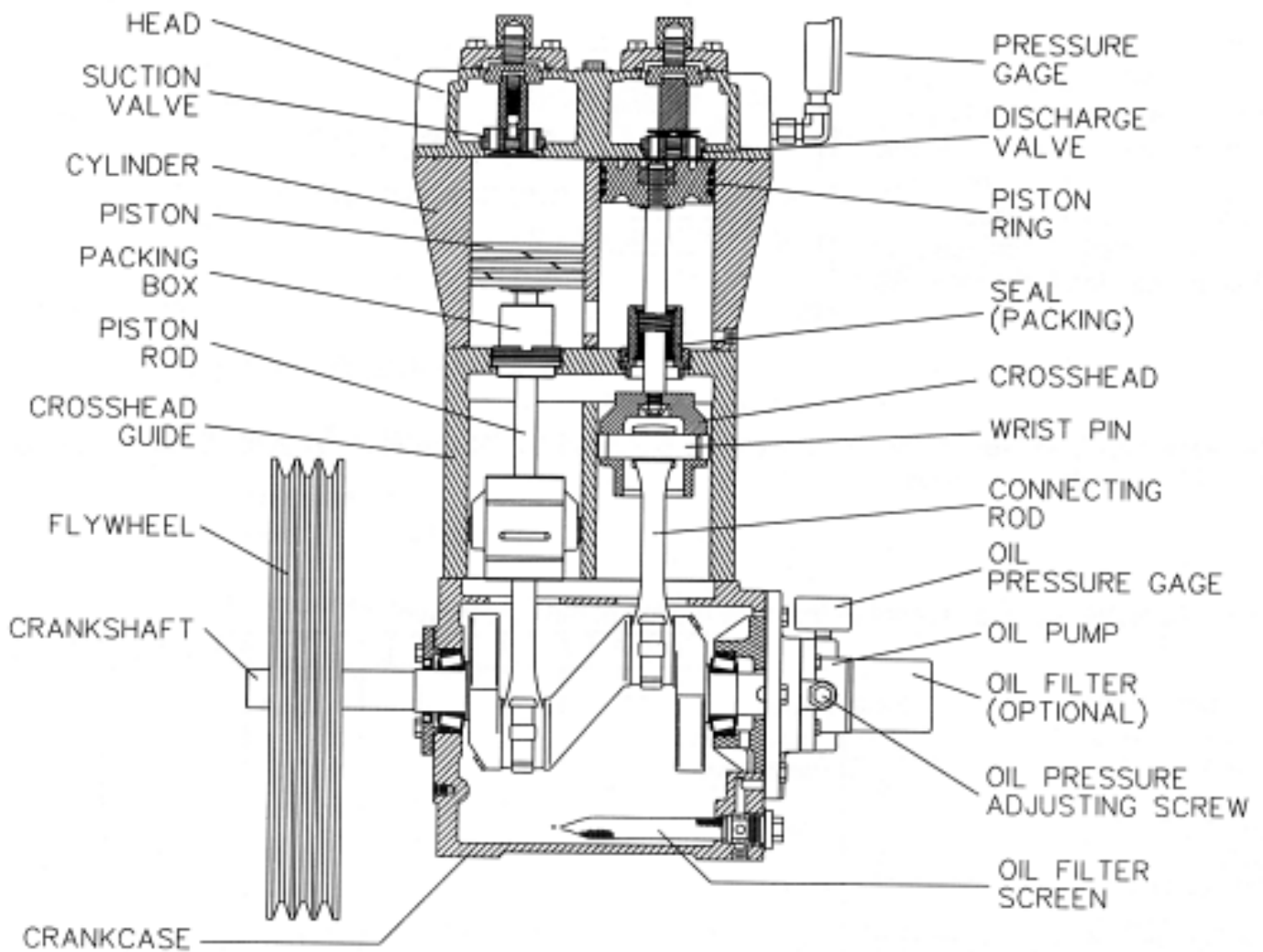


Figure 1 - Typical Compressor

The models listed are single-stage, vertical, air-cooled reciprocating style compressors with single acting cylinders.

Three basic sizes are offered with single or double seal arrangements available.

	Single-Seal Models Double-Seal Models	LB161B LB162B	LB361B LB362B	LB601B LB602B
Minimum / Maximum RPM*		350 / 825	350 / 825	350 / 790
Displacement @ min rpm-CFM (m <sup>3</sup> /hr) @ max rpm-CFM (m <sup>3</sup> /hr)		7.16 (12.2) 16.9 (28.7)	15.3 (26.0) 36.0 (61.2)	27.2 (46.3) 61.5 (104.5)
Max. BHP (kw)		10 (7.5)	15 (11)	40 (30)
MAWP - psia (kPa)		350 (2,413)		
Maximum discharge Temperature		350°F (176°C)		

\*Reduce maximum speeds by 9% for continuous duty operation.

Table 1 - Compressor Data

## GENERAL INFORMATION

### NAMEPLATE DATA

A nameplate is attached to the side of all Blackmer compressors showing the Model No., I.D. No., and Serial No.

These numbers should be available when information or parts are needed for a particular unit.

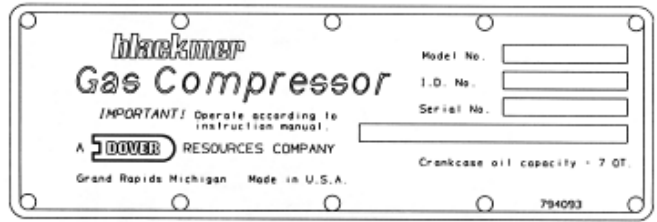
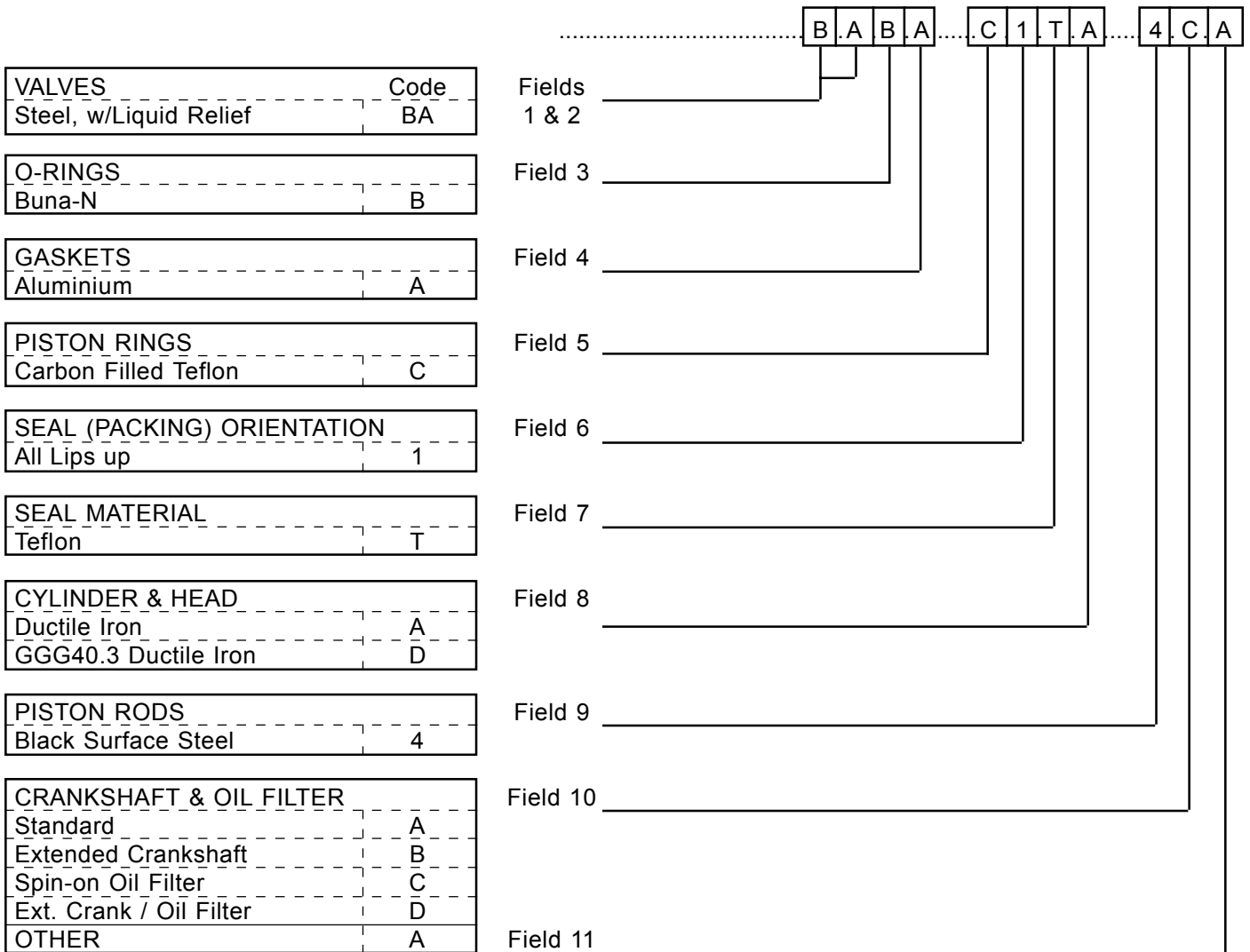


Figure 2 - Compressor Nameplate

The basic size and type of the compressor is indicated by "Model No." A suffix letter is used on most models to indicate the version.

An 11 character "I.D. No." identifies the construction of the compressor.



Note: A ' Z' in any field indicates a non-standard option.

No model is available with all shown options.

Table 2 - ID Number Key

Serial No. 6 digits and a suffix letter indicating the year of manufacture.

<b>Suffix</b>	<b>P</b>	<b>Q</b>	<b>R</b>	<b>S</b>	<b>T</b>	<b>U</b>	<b>V</b>
<b>Year</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>

Table 3 - Year of Manufacture

## GENERAL INFORMATION

### MAXIMIZING COMPRESSOR LIFE

Life of critical compressor components such as piston rings, valves and packing will vary considerably with each application, installation, and operating procedures. Premature failure of wear parts can often be attributed to one of the following causes:

#### 1. Excessive Temperatures

Primary causes are:

- Operating at pressures other than those originally specified.
- Handling a different gas than originally specified.
- Clogged strainer or filter elements.
- Line sizes too small, or other flow restrictions.
- Excessive ambient temperature or suction gas temperature.
- Valve problems. (See Foreign Material.)
- Badly worn piston rings. (See Foreign Material.)

Lower operating temperatures will increase valve and piston ring life significantly.

#### 2. Foreign Material

Solid particles in the gas stream will:

- Rapidly wear the piston rings and score the cylinder wall.
- Destroy the rod packing causing excessive leakage and score the piston rods.
- Lodge in the valves causing loss of capacity and broken valve plates and springs.

Liquid in the gas stream will:

- Cause broken valve plates and springs.
- Destroy the compressor if present in sufficient quantity.

On new installations, it is suggested that the valves and piston rings be inspected after the first few hundred hours of operation. This will give an early indication of any abnormal problems and allow for corrective action to be taken before a costly failure results. Although piston ring life will vary from application to application, wear be fairly consistent on subsequent sets of rings.

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## INSTALLATION

### LOCATION AND PIPING

Compressor life and performance can be significantly reduced when installed in an improperly designed system. Before starting layout and installation of the piping system, consider the following:

1. All piping must be leak free to a pressure of 1.5 times the maximum system pressure.

**NOTICE: If the system is to be hydrostatically tested, the compressor MUST be isolated. Liquid entering the compressor will cause damage and void the warranty.**

2. A strainer should be installed in the inlet line to protect the compressor from foreign matter. A #30 mesh screen or finer is recommended. Strainer **must** be cleaned every 180 days, or more frequently if the system requires.

3. Expansion joints, placed within 36" (0.9 m) of the compressor, will compensate for expansion and contraction of the pipes.
4. Piping **must** be adequately supported to ensure that no piping loads are placed upon the compressor.
5. Both suction and discharge piping should slope down from the compressor. The compressor should not be placed at a low point in the piping system.

## INSTALLATION

### MOUNTING THE COMPRESSOR UNIT

A solid foundation reduces noise and vibration, and will improve compressor performance. On permanent installations, it is recommended the compressor be secured by anchor bolts as shown.

This arrangement allows for slight shifting of position to accommodate alignment with the mounting holes in the base plate.

For new foundations, it is suggested that the anchor bolts be set in concrete.

When compressors are to be located on existing concrete floors, holes should be drilled into the concrete to hold the anchor bolts.

To keep vibration at a minimum, in addition to a solid concrete foundation, it is important that the concrete be located on a stable soil foundation. The base should have complete contact along its entire length with the foundation. Visible separations can result in vibration which are magnified in the upper part of the unit.

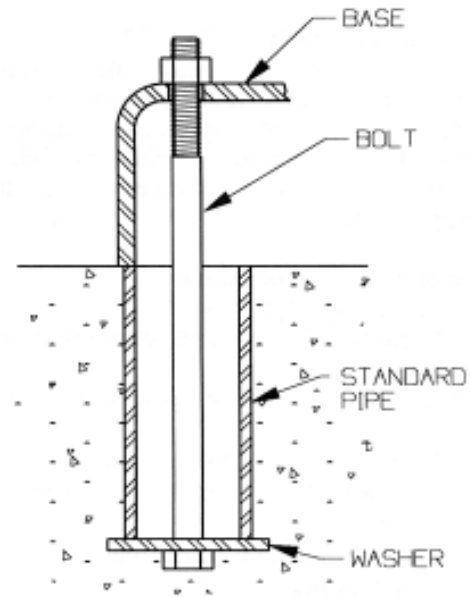


Figure 3 - Anchor Bolt

Figure 4 -  
Liquid Transfer  
Flow Schematic

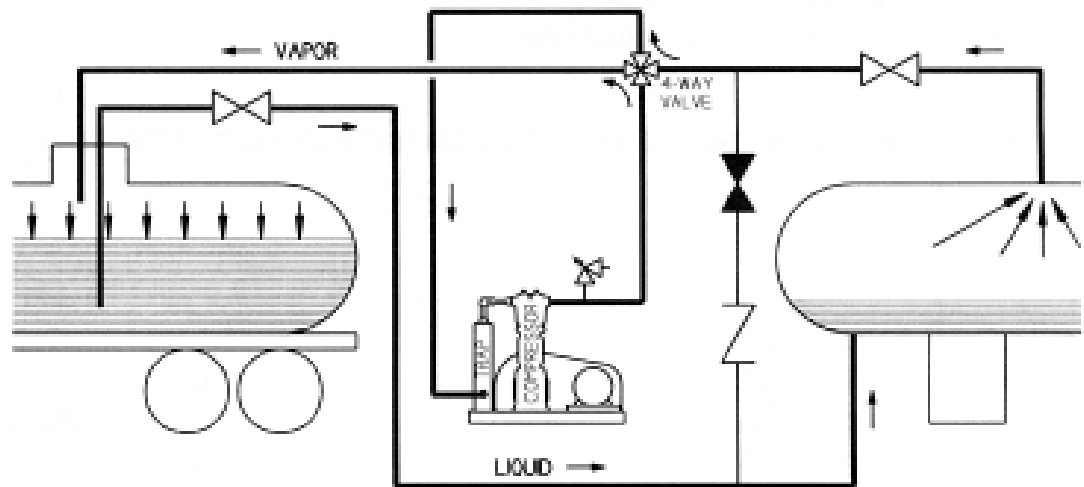
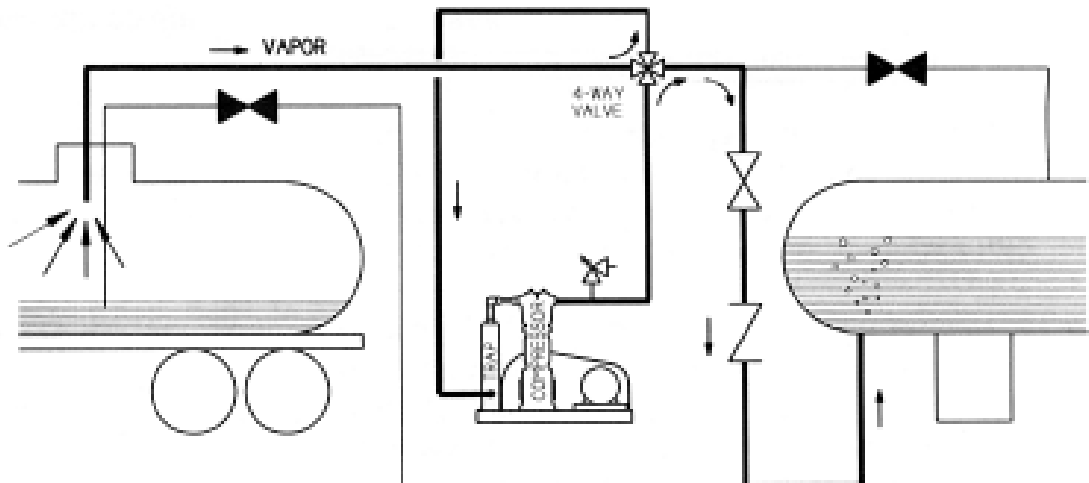


Figure 5 -  
Vapor Recovery  
Flow Schematic



## INSTALLATION

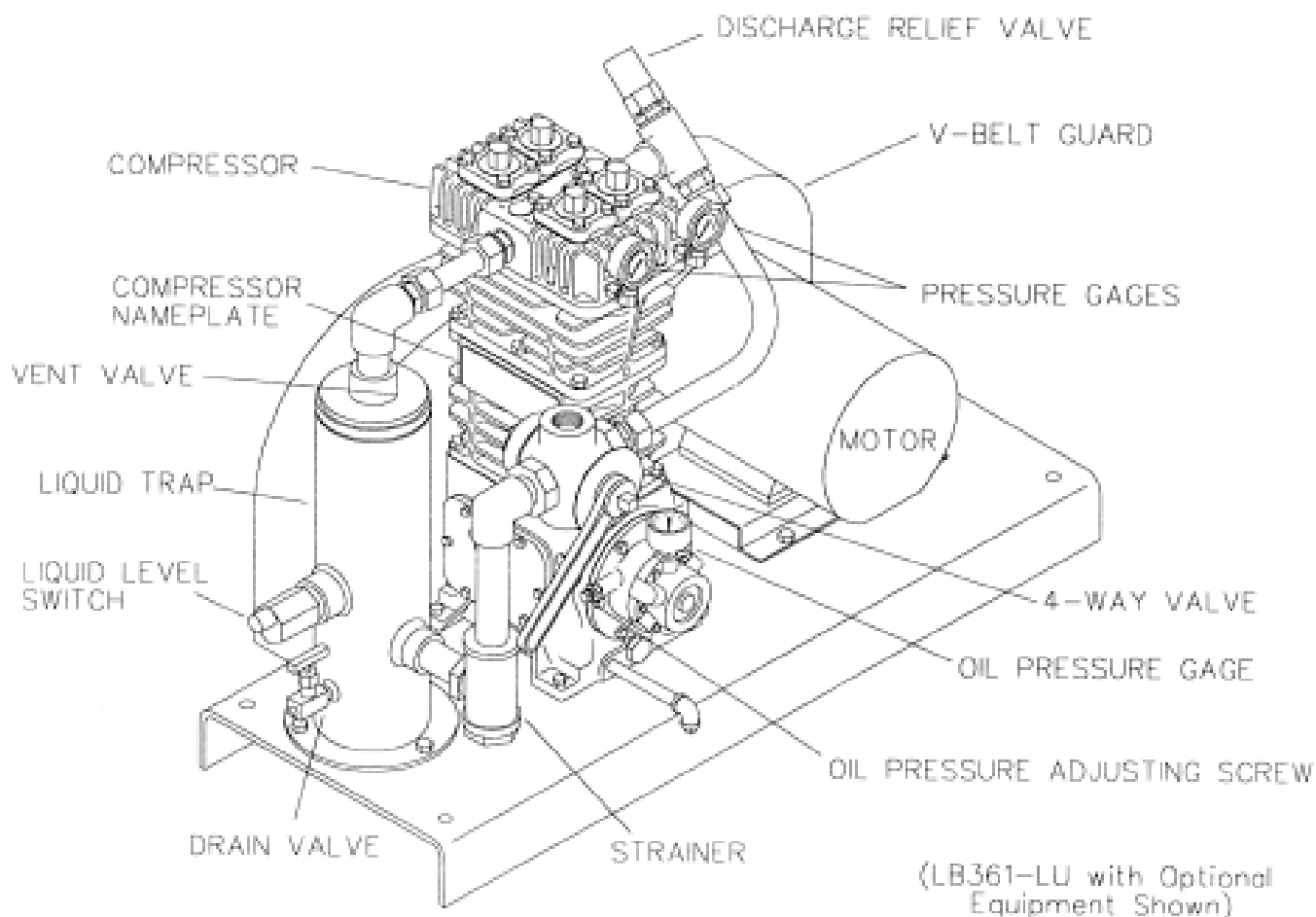
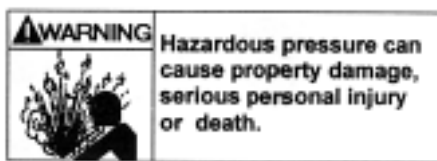


Figure 6 - Typical Liquefied Gas Transfer Compressor



### RELIEF VALVES

A relief valve of a type, material and pressure rating suitable to the installation, **MUST** be installed. The relief valve shall be installed in the discharge line between the compressor head and the first block valve.

Blackmer offer various relief valves for gas compatibility:

- Brass for LP-Gas service
- Aluminium for anhydrous ammonia
- Steel, A.S.M.E. code stamped for both services, and other applications.

### 4-WAY VALVES

Many liquefied gas compressors are used for both liquid transfer and vapor recovery operations.

An optional 4-way valve is used to reverse the direction of flow through the system when changing from liquid transfer to vapor recovery.

Both lubricated and nonlubricated models are available. Lubricated models should be lubricated every 6 months.

## INSTALLATION

### LIQUID TRAPS

Compressors handling gasses that contain condensates or other liquids **MUST** be protected from entry of the liquid.

**NOTICE: Liquid in the compressor cylinder can cause destruction of the compressor.**

Blackmer offers a variety of liquid traps. The most common variations include:

1. A non-code vessel fitted with a stainless steel float which will shut off the intake line to the compressor in the event of an excessive liquid level. A vacuum breaking valve is provided on the liquid trap head in case the trap closes and a vacuum develops between the compressor and the trap. A manual drain valve is provided.

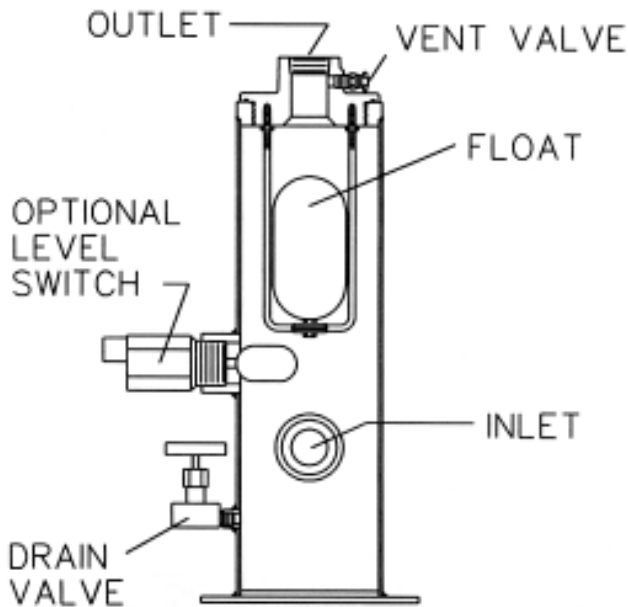


Figure 7 - Typical Liquid Trap

2. The above trap is fitted with an additional port allowing for the use of an optional electric float switch which provides protection to the compressor by stopping the compressor when a high liquid level is present in the liquid trap. The electric float switch may be used with or without the mechanical float described above.
3. For additional protection, a larger ASME code stamped vessel is available. This liquid trap is typically fitted with one or two electric float switches for both a high liquid level shut down and alarm signal, a relief valve, and a manual drain valve. Level gauges and automatic drain systems are available options.

### TEMPERATURE SWITCHES

Excessive discharge temperature is a leading cause of premature component failure and is often an early warning sign of impending problems.

Optional temperature switches should be installed with a thermowell as close to the compressor discharge as possible. The switch should be set to actuate at a temperature just above the maximum operating temperature of the compressor.

### LOW OIL PRESSURE SWITCHES

Loss of crankcase oil pressure is a rare occurrence, but can result in costly damage. An optional low oil pressure switch set at about 15 psig (1 bar-g) may be installed to shut down the compressor in the event of a lubrication failure.

A 10 second delay timer should be used to lock the low oil pressure switch out during compressor startup.

### PRESSURE SWITCHES

Pressure switches may be installed in the suction or discharge gas stream as protective devices, for compressor control, or for other uses varying with each application and system design.

### PRESSURE GAUGES

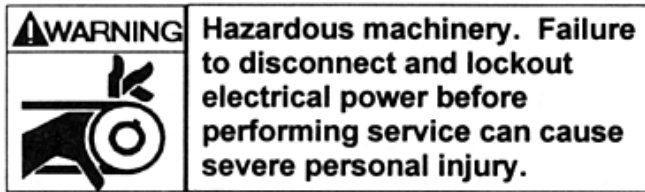
It is recommended that pressure gauges be installed in the discharge and inlet lines to verify actual suction and discharge pressures.



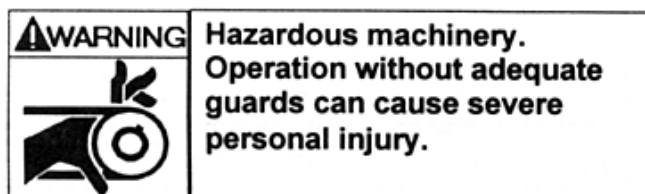


## OPERATION

### PRE-STARTUP CHECK LIST



1. After the compressor is installed in the system, a complete leak test **MUST** be performed on both the compressor and the piping.
2. Re-check the system piping and the piping supports to ensure that no piping loads are being placed on the compressor.
3. If V-belt driven, check the alignment of the motor and the compressor sheaves. The faces of the sheaves must be parallel.
4. Blackmer compressors are shipped from the factory without oil in the crankcase. Fill with a high quality non-detergent oil of the proper viscosity. See "Crankcase Lubrication" in this manual.
5. Check the electrical connections for proper wiring, grounding, etc.
6. With the power disconnected, remove the compressor nameplate. Squirt oil onto each crosshead while rotating the compressor by hand to verify smooth operation.



7. Ensure that all guarding is properly installed.



### STARTUP PROCEDURE

1. Start the compressor. Oil pressure should register 25 psig (172 kPa) within 10 seconds.

**NOTICE: If proper oil pressure is not present, stop the compressor and correct the problem.**

Operating the compressor with low oil pressure will cause severe damage to the unit.

Adjust if necessary. See "Setting the Oil Pressure" in this manual.

The oil pump on these models will operate in either direction of crankshaft rotation.

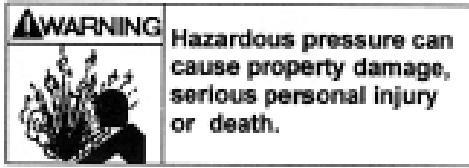
2. Verify that the suction and discharge pressures are within the expected ranges.

**NOTICE: Operating limits listed in the "Compressor Data" section must not be exceeded.**

3. Check for leakage from the piping and equipment, and repair as necessary.
4. If the seals (packing) have just been replaced, the lower seal **MUST** be manually lubricated during the first 60 minutes of operation. See "Seal (Packing) Replacement" section. New compressors have had the packing broken in at the factory.
5. On newly rebuilt units, the valve hold down screws, valve cover plate bolts and cylinder head bolts **MUST** have their torque checked after 60 minutes running time. Also retighten all hold down bolts, flywheel bolts, etc. after 60 minutes running time. See Table 6 - "Bolt Torque".



## MAINTENANCE



1. Before work is started on the compressor make sure all pressure is bled off on both the suction and discharge.

2. When performing service or maintenance to the compressor, refer to the appropriate Blackmer Parts List for detailed views and identification of compressor parts.

**NOTICE:** Blackmer compressor service and maintenance shall be performed by qualified technicians only. Service and maintenance shall conform to all applicable local and national regulations and safety standards.

### SERVICE SCHEDULE

	Daily	Weekly	Monthly	6 Months	Yearly
Overall Visual Check	X				
Check Crankcase Oil Pressure	X				
Check Suction Pressure	X				
Check Discharge Pressure	X				
Drain Drainage Piece (Double-Seal Models)		X			
Drain Liquid From Accumulation Points		X			
Clean Compressor Cooling Fins		X			
Check Crankcase Oil Level*			X*		
Check V-Belt Tension			X		
Change Oil* and Optional External Oil Filter				X*	
Check Inlet Filter/Strainer Element				X	
Inspect Valves				X	
Lubricate 4-way Valve				X	
Lubricate Motor Bearings per Manufacturer's Suggestions				X	
Inspect Motor Starter Contact Points					X
* Change oil every 1,000 hours of operation (2,000 hours with optional external oil filter), or every 6 months which ever occurs first. If the oil becomes unusually dirty, change oil and external filter as often as needed to maintain clean oil.					

Table 4 - Service Schedule

## MAINTENANCE

### TOOL LIST

Description	Used For:
Blackmer Wrench 790535	Valve Hold-down screw
Blackmer Packing Installation Tool 790536 for 160 and 360 Series Compressors 790538 for 600 Series Compressors	Rod-packing protection during installation.
3" Adjustable Spanner with 1/4" pins (Blackmer PN 790316)	Piston Nut, Piston, Packing Box Hold-down Ring
9/16", 5/8" or 3/4" End Wrench	Cylinder and Crosshead Guide
1 - 1/16" Wrench or Socket	Valve Caps
Allen Wrenches: 3/16", 1/4", 3/8"	Valves
Sockets: 7/16", 1/2", 9/16", 5/8", 3/4", 7/8"	Various
Internal Snap Ring Pliers	Seal Replacement
Feeler gauges or Depth Micrometer	Piston Clearance
Screwdriver, Flat Blade	Nameplate screws, Packing Installation
Pliers	
Rubber Mallet	
Arbor Press	Wrist Pin Removal
Bearing Puller	Crankshaft Bearings
Torque Wrench, 0 to 45 lb-ft range	Various
Hoist (useful)	Cylinder and Crosshead Guide

Table 5 - TOOL LIST

### BOLT TORQUE FOR BLACKMER COMPRESSOR LBS-FT (Nm)

Size	Connectin Rod Bolt	Bearing Carrier	Bearing Cover Plate	Crankcase Inspection Plate	Crosshead Guide	Cylinder	Head	Valve Cover Plate	Valve Hold Down Screw
160	30 (40.7)	30 (40.7)	35 (47.5)	7 (9.5)	25 (33.9)	25 (33.9)	20 (27.1)	--	40 (54.2)
360	35 (47.5)	30 (40.7)	35 (47.5)	7 (9.5)	35 (47.5)	35 (47.5)	40 (54.2)	35 (47.5)	40 (54.2)
600	45 (61.0)	30 (40.7)	40 (54.2)	7 (9.5)	40 (54.2)	40 (54.2)	40 (54.2)	35 (47.5)	40 (54.2)

Table 6 - Bolt Torque

## MAINTENANCE

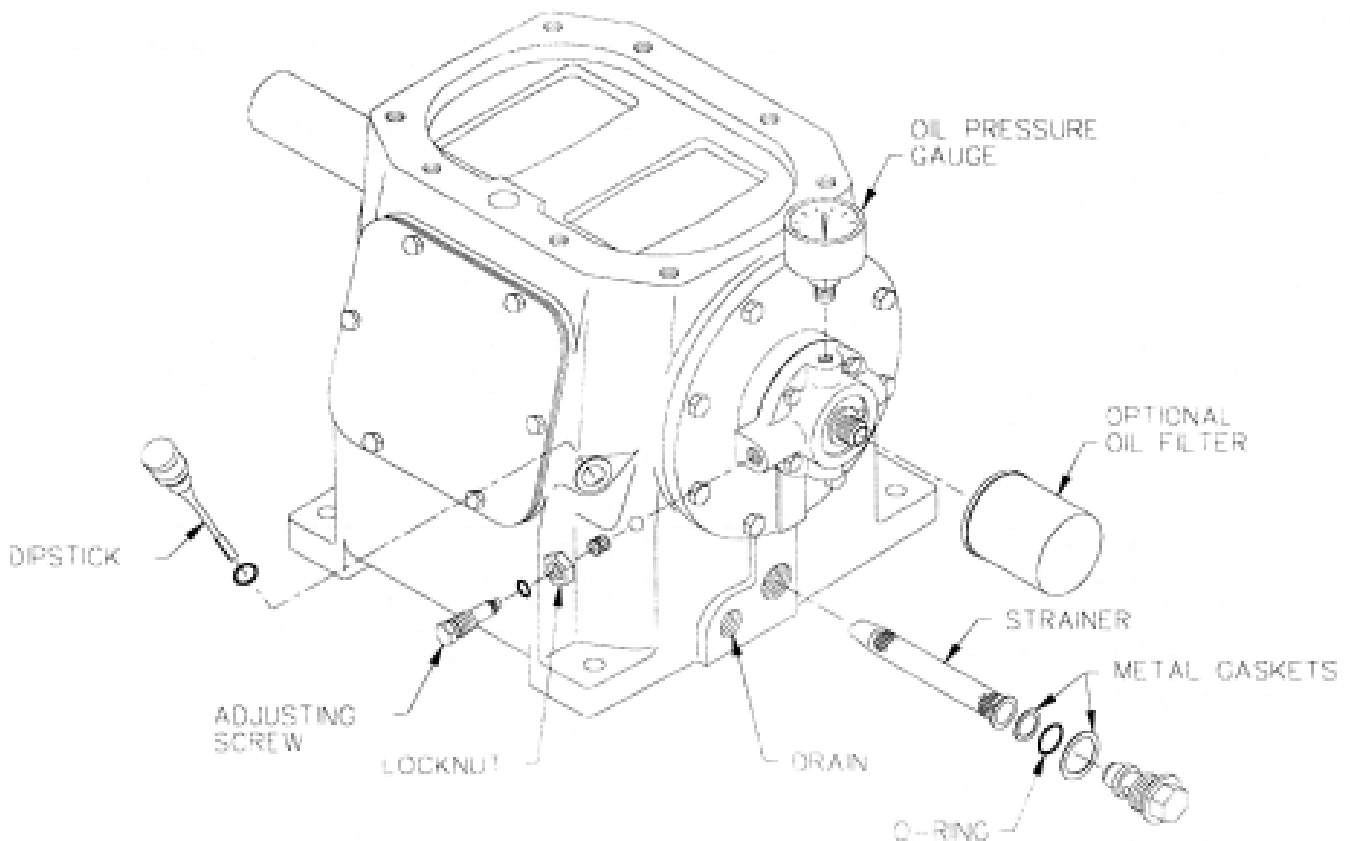


Figure 8 - Compressor Lubrication System

### CRANKCASE LUBRICATION

Change the crankcase oil every 1,000 hours or 180 days, whichever is shorter.

Under severe dusty or sandy operating conditions, the oil should be changed every 500 hours or every 90 days. When equipped with an optional spin-on oil filter, intervals between oil changes may double, but must not exceed 180 days.

A high quality non-detergent oil is recommended.

Consult factory for special lubricating requirements.

Models	Quarts
LB 161 B , LB 162 B	2
LB 361 B , LB 362 C	3
LB 601 B , LB 602 B	7

Table 7 - Oil Capacity

Air Temperature	Oil Viscosity
Below 0°F (-18°C)	SAE 5 W
0 to 32°F (-18 to 0°C)	SAE 10 W
32 to 80°F (0 to 27°C)	SAE 20 W
80°F (27°C) and above	SAE 30 W

Table 8 - Oil Viscosity

Before changing the oil, bring the compressor up to normal operating temperature.

Remove the crankcase drain plug and drain the oil into an adequately sized container.

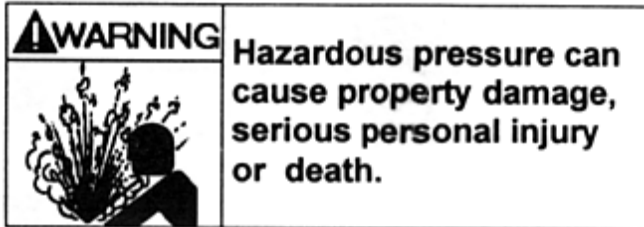
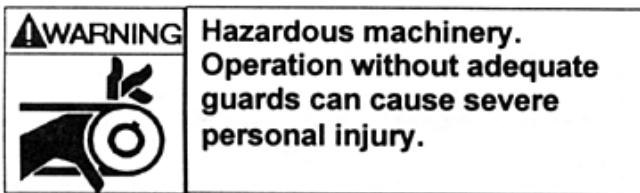
Remove the oil pickup screen and clean in a suitable solvent. When reinstalling the pickup screen, inspect the metal gasket and the O-ring for damage, replacing as necessary. If equipped, replace the optional external oil filter. See Figure 8.

### SETTING THE OIL PRESSURE (see Figure 8)

1. The oil pressure should be about 25 psig (173 KPa).
2. Loosen the locknut.
3. Increase the pressure setting by turning the adjusting screw inward, **CLOCKWISE**.  
Decrease the pressure setting by turning the adjusting screw outward, **COUNTERCLOCKWISE**.
4. Retighten the locknut.



## COMPRESSOR DISASSEMBLY



**NOTICE:** Before starting work on the compressor, make sure all pressure is bled off on both the suction and discharge.

1. Remove the center head capscrews from the cylinder head. Remove the outer cylinder head capscrews.
2. Remove the cylinder head assembly and cylinder head O-rings from the cylinder. The suction and discharge valve assemblies will come off with the cylinder head. For valve replacement instruction, refer to the "Valve Replacement" section of this manual.
3. Removal of the piston requires a 32 adjustable spanner wrench with 1/4" pins, such as Blackmer PN 790316.
  - a. Rotate the flywheel by hand to bring a piston to top dead center of the cylinder.
  - b. Remove the piston nut by turning the nut counterclockwise. (The nylon locking insert in the piston nut must be replaced during reassembly.)
  - c. To remove the piston from the cylinder, turn it counterclockwise with the use of the adjustable spanner wrench. For removal and replacement of the piston rings, refer to the "Compressor Assembly" section.
  - d. Remove the thrust washer and any shims. Keep the shims and piston together.
  - e. Repeat these steps for the other piston.
4. Remove the cylinder capscrews.
5. Lift the cylinder and cylinder O-rings from the crosshead guide (or distance piece).

6. Packing Box Removal
  - a. Using an adjustable spanner wrench, remove the packing box hold-down rings. (Replace the nylon locking inserts in the hold-down rings during reassembly.)
  - b. Remove the packing box and packing box O-ring from each piston rod. Double-Seal models will also have a spacer ring and a second packing box O-ring to remove from each piston rod.
  - c. For disassembly of the packing boxes, refer to the "Seal (Packing) Replacement" section of this manual.
7. Remove the crosshead guide capscrews, and lift the crosshead guide and gasket from the crankcase.
8. To remove the connecting rod assemblies, with the crossheads attached, it may be necessary to drain the oil from the crankcase. The piston rod is permanently attached to the crosshead to form a single assembly. Do not attempt disassembly.
  - a. Remove the inspection plate from the crankcase.
  - b. Remove the locknuts from the connecting rod bolts. This will release the connecting rod cap (the lower half of the connecting rod) and the two halves of the bearing insert. The connecting rod and the connecting rod cap are marked with a dot on one side so that they can be properly aligned when reassembling.
  - c. Lift the crosshead assembly and connecting rod off the top of the crankcase.

**NOTICE:** The connecting rod parts are not interchangeable and must be reassembled with the same upper and lower halves. To avoid confusion, work on one connecting rod at a time, or mark the individual halves with corresponding numbers.
9. Remove the opposite connecting rod and crosshead assembly in the same manner as outlined in step 8.

## COMPRESSOR DISASSEMBLY

10. Rest the crosshead assembly on a bench. Carefully drive the wrist pin and wrist pin plugs out of the crosshead and connecting rod using a suitable pin driver or an arbor press. Removal of the pin releases the crosshead assembly from the connecting rod.
12. If necessary, the wrist pin bushing can be replaced after the crossheads are removed. New bushing must be honed to the proper size after installation.
13. To replace the crankshaft bearings, the crankcase must be disassembled, and the crankshaft removed. refer to the "Bearing Replacement" section of this manual.

Compressor Model	Bushing I.D. Inches (mm)
<b>LB 161 B , LB 162 B LB 361 B , LB 362 C</b>	<b>0.8753 to 0.8756 (22.233 to 22.240)</b>
<b>LB 601 B , LB 602 B</b>	<b>1.2511 to 1.2514 (31.778 to 31.786)</b>

Table 9 - Wrist Pin Bushing Dimensions

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## COMPRESSOR ASSEMBLY

### COMPRESSOR ASSEMBLY

Compressor assembly is generally the opposite of compressor disassembly. Before reassembling, clean each part thoroughly. Check all machined surfaces for burrs or roughness, and file lightly if necessary.

**Replace any O-rings or gaskets that are removed or disturbed during service.**

#### 1. CRANKCASE ASSEMBLY

After replacing the crankshaft, bearing carrier, and bearing cover plate, the connecting rod and crosshead can be assembled in the crankcase. See the "Bearing Replacement" section.

- a. To attach the connecting rod to the crosshead assembly, first coat the wrist pin, the wrist pin bore in the crosshead assembly, and the wrist pin bushing in the connecting rod with grease.
- b. Start the wrist pin in the bore of the crosshead assembly and tap lightly until the pin begins to project through to the inside of the crosshead assembly.
- c. Slide the connecting rod up inside of the crosshead assembly and align the bushing with the wrist pin.

- d. Lightly tap the wrist pin through the connecting rod until it is centered in the crosshead assembly. The wrist pin should be snug in the crosshead assembly. The connecting rod should rotate freely on the wrist pin, but should not be loose.
  - e. Dip the wrist pin plugs in grease and press them against the ends of the wrist pin.
  - f. Place the bearing halves into each half of the connecting rod, aligning the bearing tangs with the slots in the connecting rod. Coat the bearing with grease.
  - g. Set the top of the connecting rod over the crankshaft journal. Replace the connecting rod cap with the dots on the connecting rod and cap on the same side.
  - h. Start the nuts on the connecting rod bolts and torque per Table 6 - "Bolt Torque."
  - i. Follow this same procedure for the opposite connecting rod.
- #### 2. CROSSHEAD GUIDE
- a. Place the crosshead guide gasket on top of the crankcase.
  - b. Lubricate the inside bore of the crosshead guide with light oil.

## COMPRESSOR ASSEMBLY

- c. Set the crosshead guide over the piston rods and the crossheads, and slowly lower it against the crankcase. Make certain that the crosshead assemblies are started straight in the bores of the crosshead guide to prevent binding when lowering the crosshead guide into position.
  - d. Install the crosshead guide capscrews. DO NOT tighten.
3. Fill the crankcase with oil. Refer to the "Crankcase Lubrication" section. Squirt oil into the crankshaft, roller bearings, crankshaft journals, and crosshead assemblies to ensure proper lubrication at start up.
  4. Attach the inspection plate and the inspection plate gasket to the crankcase.
  5. **PACKING BOX ASSEMBLIES**

Before installing the packing boxes into the crosshead guide, inspect the piston rods for scoring or roughness. Remove any burrs or sharp edges. Lubricate the piston rods and packing box O-rings with light oil. **Do not damage the packing when starting it over the rod.**

**Single-Seal Models**

    - a. Insert the packing box O-ring into the crosshead guide.
    - b. Start the packing box assembly, short end down, over the piston rod and into the counter-bored hole of the crosshead guide.
    - c. Install the packing box retainer ring, with new nylon locking inserts, and tighten securely.
    - d. Repeat the above steps for the remaining packing box.

**Double-Seal Models**

    - a. Insert the lower packing box O-ring into the crosshead guide.
    - b. Start the packing box assembly, short end down, over the piston rod and into the crosshead guide.
  - c. After the lower set of packing is started over the piston rod, make sure the oil deflector ring is properly aligned (with the flat side down) over the piston rod. Use the hole in the side of the packing box to center the deflector ring. Once the deflector ring is over the rod, the packing box can be fully inserted.
  - d. Install the upper packing box O-ring on the end of the packing box.
  - e. Place the packing box spacer ring over the O-ring.
  - f. Install the packing box retainer ring, with new nylon locking inserts, and tighten securely.
  - g. Repeat the above steps for the remaining packing box.
6. Rotate the crankshaft by hand a few times, then uniformly tighten the crosshead guide capscrews per Table 6 - "Bolt Torque".
  7. Break in new packing per the "Seal (Packing) Replacement" section of this manual.
  8. **CYLINDER ASSEMBLY**
    - a. Install new O-rings in the bottom of the cylinder. A small amount of grease may be used to hold the O-rings in place during assembly.
    - b. Set the cylinder over the piston rods and against the crosshead guide.
    - c. Install the cylinder capscrews. DO NOT tighten.
  9. **PISTON RINGS**
    - a. Place an expander in the top groove of the piston. Place an expander in the second groove with the break in the expander 180 degrees from the break of the top expander. Place the third expander in the bottom groove with its break in the same position as the top expander.
    - b. Place piston rings in all three grooves of the piston. Align the breaks in the piston rings directly opposite the breaks in the corresponding expanders.

## COMPRESSOR ASSEMBLY

### 10. PISTONS

- a. Rotate the flywheel by hand to bring one piston rod to top dead center of the cylinder assembly.
- b. Set the thrust washer and one shim on the shoulder of the piston rod.
- c. With light pressure, squeeze the piston rings inward while threading the piston clockwise onto the rod. Tighten with the 3" adjustable spanner wrench.
- d. Follow this same procedure for the second piston.
- e. Rotate the crankshaft by hand a number of times to verify that the pistons are centered in the cylinder bores. Adjust the cylinder so that the pistons DO NOT touch the cylinder walls.
- f. Using an alternating pattern, torque the cylinder capscrews per Table 6 - "Bolt Torque."

### 11. PISTON CLEARANCE

- a. Rotate the flywheel by hand to bring one piston to the top.
- b. Measure the distance from the top of the piston to the top of the cylinder.

<b>LB 161 B</b>	<b>.010" to .025"</b> <b>(.254 to .635 mm)</b>
<b>LB 162 B</b>	<b>.015" to .030"</b> <b>(.381 to .762 mm)</b>
<b>LB 361 B</b>	<b>.020" to .035"</b> <b>(.508 to .889 mm)</b>
<b>LB 362 C</b>	<b>.025" to .040"</b> <b>(.635 to 1.016 mm)</b>
<b>LB 601 B</b>	<b>.020" to .035"</b> <b>(.508 to .889 mm)</b>
<b>LB 602 B</b>	<b>.030" to .045"</b> <b>(.762 to 1.143 mm)</b>

Table 10 - Piston Clearance

- c. If necessary, remove the piston and add or subtract shims accordingly.
- d. Install new nylon locking inserts in the piston retainer nuts.
- e. Thread the piston nut onto the piston rod and tighten securely with the spanner wrench.
- f. Follow this same procedure for the second piston.

### 12. CYLINDER HEAD ASSEMBLY

If the valve assemblies have been removed from the cylinder head, refer to the "Valve Replacement" section of this manual.

- a. Place the cylinder head O-rings in the grooves located on top of the cylinder.
- b. Place the cylinder head assembly on top of the cylinder.
- c. Hand tighten the outer capscrews and center capscrews into the cylinder head.  
Gaskets MUST be used on the center capscrews of the LB 161 and LB 162 models.
- d. Uniformly torque the cylinder head capscrews per Table 6 - "Bolt Torque."

13. Rotate the compressor by hand to verify that it turns freely. Ensure that the pistons are not hitting the cylinder head assembly.
14. Follow all procedures listed in the "Pre-Startup Check List" and "Startup Procedure" sections of this manual.
15. Start the compressor and bring to normal operating temperature.  
Stop the compressor, allow it to cool and retorque the valve hold down screws per Table 6 - "Bolt Torque."



## VALVE REPLACEMENT

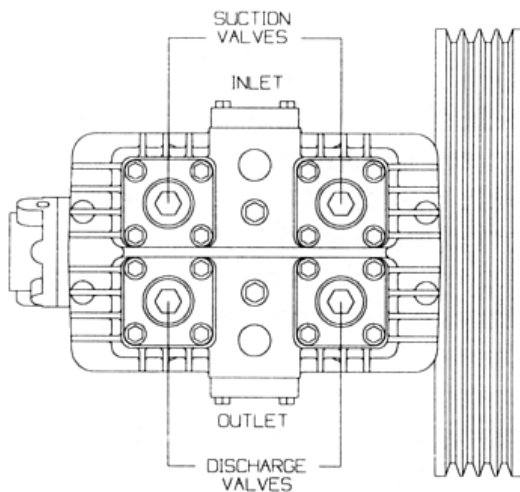


Figure 9 - Valve Location

Suction and discharge valves **MUST** be installed in the correct cylinder head locations. See Figure 9.

**MODELS LB 161 B or LB 162 B** - see Figure 10.

1. Remove the valve cap and O-ring from the valve being serviced.
2. Remove the valve hold down screw with a spanner wrench, such as Blackmer PN 790535.

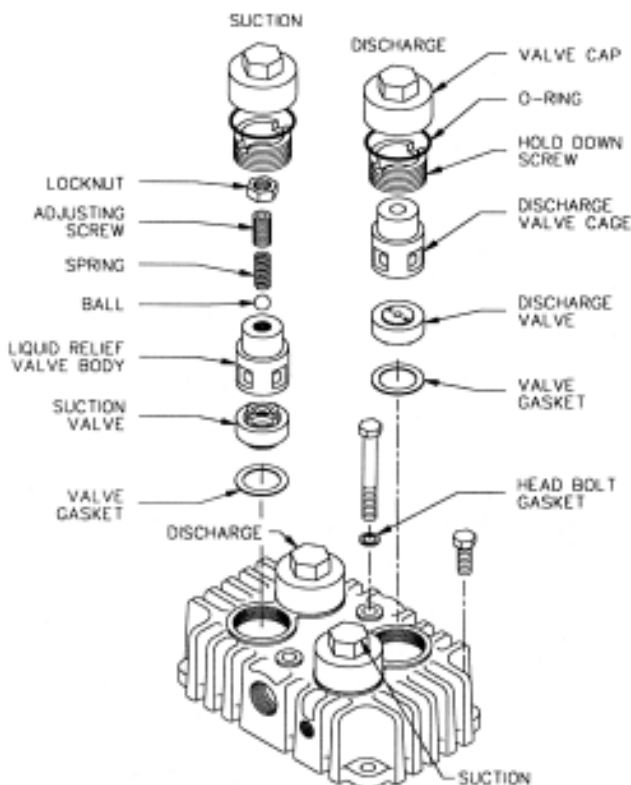


Figure 10 - LB 161 or LB 162 Valves

3. Suction valve - Remove the liquid relief valve body, valve assembly and gasket. **DO NOT** drop the liquid relief ball and spring into the head interior.
4. Discharge valve - Remove the discharge valve cage, valve assembly and gasket.
5. Inspect the valve for wear or breakage.
6. Ensure that the old gasket is removed, then install a new valve gasket.
7. To reinstall the suction valves:
  - a. Install the valve assembly in the cylinder head. Ensure the correct orientation and location of the valve.
  - b. Center the liquid relief body on the valve assembly.
  - c. Install the hold down screw and tighten per Table 6 - "Bolt Torque."
  - d. Drop the liquid relief ball and the liquid relief spring into the opening of the liquid relief body.
  - e. Insert the liquid relief adjusting screw and adjust clockwise until the top of the screw is approximately 3/8" (9.5 mm) above the top of the liquid relief body. Add the locknut and tighten securely.
8. To reinstall the discharge valves:
  - a. Install the valve assembly in the cylinder head. Verify the correct valve orientation and location.
  - b. Center the valve cage on the valve assembly.
  - c. Install the hold down screw and tighten per Table 6 - "Bolt Torque."
9. Install the valve cap and O-ring. A little oil or grease on the O-ring will help hold it in place during installation.
10. After replacing the valves, rotate the flywheel by hand to check for interference between the pistons and the valves.
11. After 60 minutes running time, remove the valve cap and retorque the hold down screw. Replace the valve cap and O-ring.



## VALVE REPLACEMENT

### MODELS LB361B, LB362C, LB601B or LB602B

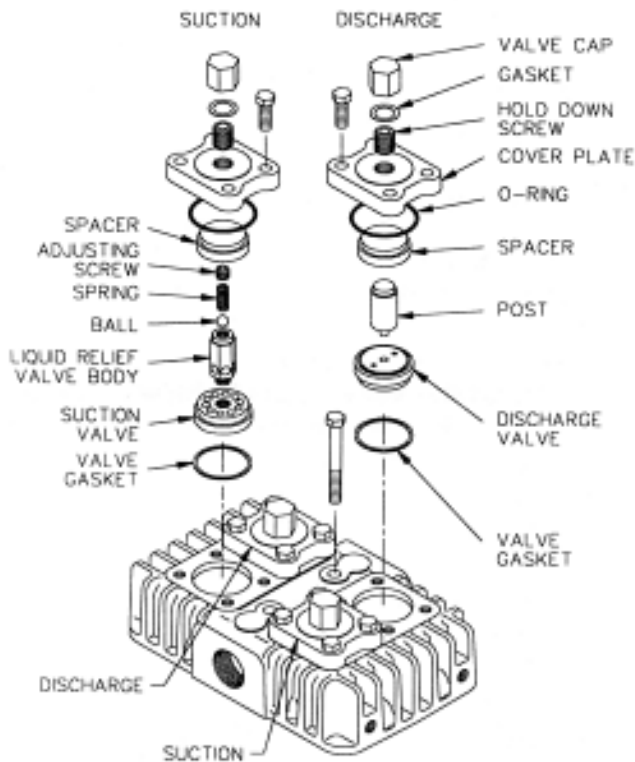


Figure 11 -  
LB 361, LB 362, LB 601 & LB602 Valves

1. Remove the valve cap and gasket from the valve being serviced.
2. **Remove** the valve hold down screw with an allen wrench.
3. Remove the valve cover plate capscrews then lift off the cover plate and O-ring.
4. Suction valves: remove the spacer, suction valve assembly and valve gasket.
5. Discharge valves: remove the spacer, post, discharge valve, and valve gasket.
6. Inspect the valve for wear or breakage. Repair or replace as necessary.

7. To reinstall the suction valves:
  - a. Adjust the liquid relief valve adjusting screw clockwise until the screw is flush with the top of the liquid relief valve body, or no more than 1/16" (1.6 mm) above the top of the liquid relief valve body.
  - b. Ensure that the old gasket is removed, then install a new valve gasket.
  - c. Install the valve assembly with the liquid relief valve upward. Verify the correct valve orientation and location.
  - d. Install the valve spacer.
  - e. Ensure the valve hold down screw is removed from the cover plate, then place the cover plate and new O-ring in position.
  - f. Install the valve cover plate capscrews and tighten per Table 6 - "Bolt Torque."
  - g. Install and tighten the hold down screw per Table 6 - "Bolt Torque."
  - h. Install the valve cap with a new gasket.
8. To reinstall the discharge valves:
  - a. Ensure that the old gasket is removed, then install a new valve gasket.
  - b. Install the valve assembly with the plug downward. Verify the correct valve orientation and location.
  - c. Install the valve post, small end first.
  - d. Install the valve spacer.
  - e. Ensure the valve hold down screw is removed from the cover plate, then place the cover plate and new O-ring in position.
  - f. Install the valve cover plate capscrews and tighten per Table 6 - "Bolt Torque."
  - g. Install and tighten the hold down screw per Table 6 - "Bolt Torque."
  - h. Install the valve cap with a new gasket.
9. After replacing the valves, rotate the flywheel by hand to check for interference between the pistons and the valves.
10. After 60 minutes running time, remove the valve cap and retorque the hold down screw. Replace the valve cap and gasket.



## SEAL (PACKING) REPLACEMENT

1. Follow steps 1 through 6 of the "Compressor Disassembly" section of this manual.
2. Remove the upper and lower retainer ring from the packing box being serviced.  
Disassemble the packing box and discard the old packing sets and packing springs.

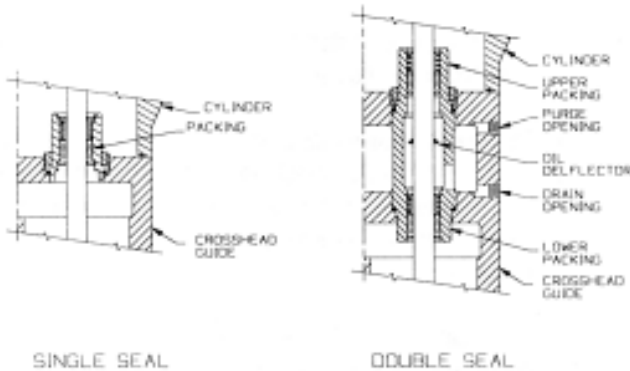


Figure 12 - TYPE 1 Seal Orientation

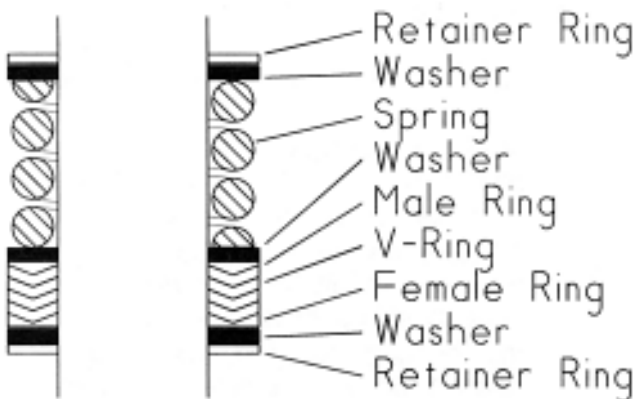
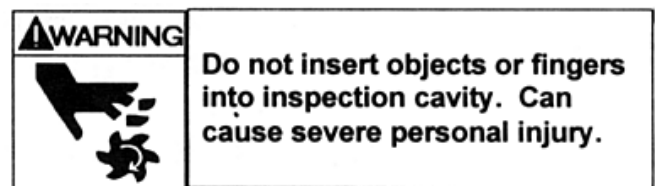


Figure 13 - Typical Seal Assembly

3. Clean the packing box in a suitable solvent.  
Inspect the bore for wear, roughness, or corrosion.  
Clean or replace as necessary.
4. Ensure that the 6<sup>th</sup> digit of the Compressor ID number is a "1", indicating a TYPE 1 packing arrangement. See "Nameplate Data" in this manual.  
Refer to Figures 12 and 13 for proper TYPE 1 component location and orientation.

### 5. Single-Seal Packing Boxes

- a. Install the lower retainer ring.
- b. Install the packing rings, spring, washers, and the upper retainer ring. To ease installation on the second retainer ring, use a screwdriver handle and press on the last washer to compress the seal spring slightly.
- c. Insert the oil deflector ring through the top of the packing box, flat side down, into the cavity between the upper and lower packing.  
The oil deflector ring will be positioned between the two sets of packing.
- d. Install the upper packing set starting with the inner retainer ring.



7. The lower packing **MUST** be manually lubricated with oil several times during the first 60 minutes of compressor operation.  
This will prevent overheating of the piston rods and potential damage to the packing material.  
To lubricate the packing:
  - a. Remove the inspection plate from the crosshead guide.
  - b. **Stop** the compressor approximately every 5 minutes to allow adequate cooling of the piston rods.
  - c. Using a small oil can, lubricate the piston rods each time the compressor is **stopped**.
8. Proceed according to steps 5 through 15 of the "Compressor Assembly" section.

## BEARING REPLACEMENT

**NOTICE: When replacing the bearings, the entire bearing assembly, including the bearing cup and the bearing cone, must be replaced.**

1. Follow steps 1 through 12 of the "Compressor Disassembly" section.
2. Remove the Oil Pump per the section titled "Oil Pump Replacement".
3. Remove the flywheel.
4. Remove the bearing carrier and gasket from the outboard end of the crankcase. The outboard bearing cup will come off with the bearing carrier and will need to be removed with a bearing removal tool.
5. Remove the key from the crankshaft and slide the crankshaft through the outboard end of the crankcase. The bearing cones can then be removed with a bearing puller.
6. Remove the bearing cover plate from the inboard end of the crankcase. The inboard bearing cup is pressed into the crankcase and can be removed with the use of a bearing removal tool.

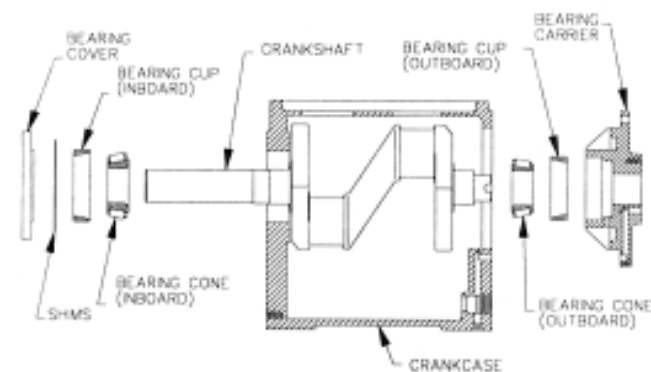


Figure 14 - Bearing Locations

7. To install the bearings:
  - a. Grease the outer edges of the bearing cups.
  - b. Referring to Figure 14 for the proper orientation, carefully press the inboard bearing cup into the crankcase until it is flush with the outer surface of the crankcase.

- c. Note the proper orientation and carefully press the outboard bearing cup into the bearing carrier assembly.
  - d. Press a bearing cone onto each end of the crankshaft with the tapered end outward. The bearing race should rest against the shoulder on the crankshaft.
  - e. Lubricate the bearings with grease.
8. Install the crankshaft through the outboard end of the crankcase.
9. With the oil pump assembly removed, install the bearing carrier and new gasket. The bolt hole position ensure proper orientation. Tighten the bolts evenly per Table 6 - "Bolt Torque."
10. If the bearings have not been replaced, reinstall the inboard bearing cover plate using the existing shim set. If the bearings have been replaced, use a **thicker** set of shims.
11. Rotate the crankshaft by hand to verify free movement of the shaft.
  - a. If the crankshaft has an excessive amount of end play, too many shims have been used. Lateral crankshaft movement (end play) between the bearings should be 0.0015 to 0.0030" (0.038 to 0.076 mm). If necessary, remove shims until the end play is within tolerance.
  - b. If the crankshaft binds, or will not turn, not enough shims have been used pushing the bearing cup too tight against the bearing cone. Remove the crankshaft from the crankcase and drive the inboard bearing cup out toward the inboard side of the crankcase. Reinstall the crankshaft and the bearing cover plate using additional shims as required.
12. Install the oil pump per the "Oil Pump Replacement" section of this manual.
13. Reassemble the compressor according to the "Compressor Assembly" section.

## OIL PUMP REPLACEMENT

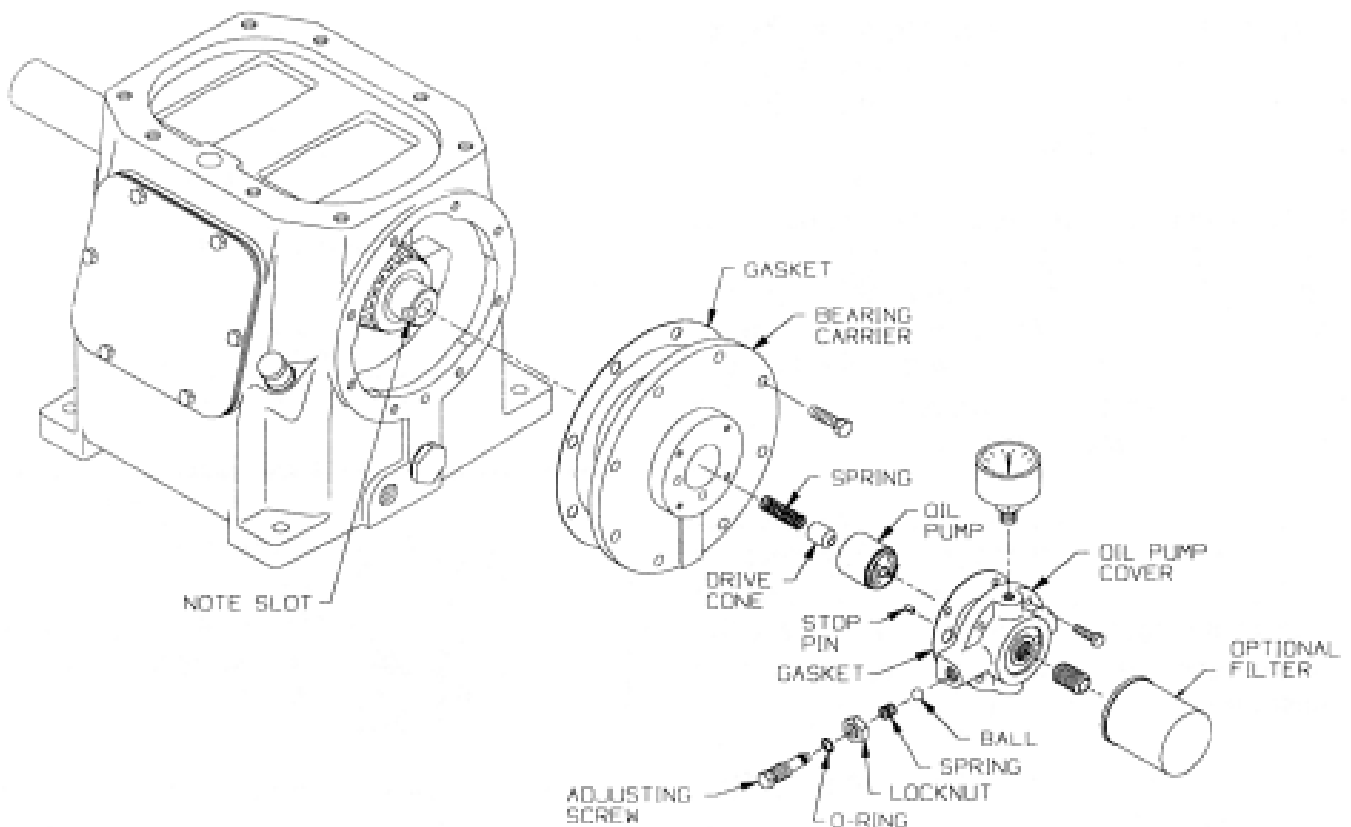


Figure 15 - Oil Pump

1. Remove the oil pump cover bolts and the oil pump cover.
2. Remove the oil pump assembly, drive cone and spring.
3. Clean and inspect parts for wear or damage, replace as necessary.
4. Place the spring and the drive cone in the end of the crankshaft.
5. Note the slot in the end of the crankshaft and the drive tab on the back of the oil pump assembly. Install the oil pump assembly into the bearing carrier with the tab and slot aligned.
6. Note the groove around outer edge of the oil pump assembly and the stop pin in the oil pump cover. Position the oil pump cover and new gasket with the pin in the oil pump groove, rotating the oil pump as needed. The bolt hole positions ensure proper orientation of the oil pump cover.
7. BY HAND, tighten the oil pump cover bolts while the pump cover is held flush with the bearing carrier.

**NOTICE: If by hand tightening, the oil pump cover cannot be drawn flush with the bearing carrier, the drive tab or the stop pin are improperly aligned. DO NOT WRENCH TIGHTEN OR THE OIL PUMP WILL BE DAMAGED.**

8. Once the oil pump cover is secured by hand, the bolts may be evenly tightened per Table 6 - "Bolt Torque."



## EXTENDED STORAGE PROCEDURES

If a compressor is not to be put into service for some time, or if a compressor is to be taken out of service for an extended period, the following procedures should be taken.

1. Fill the crankcase with rust inhibiting oil. (New compressors are shipped from the factory without oil.) Squirt oil on the piston rods and crosshead through the nameplate opening. Loosen the V-belts to relieve the load on the bearings. Rotate the compressor by hand a few times to distribute the oil.

2. Plug all openings and purge the compressor with an inert gas such as nitrogen or **dry** air at about 50 psig (3.5 bar-g). This may be done at the factory if requested. Leave the compressor pressurized to prevent air or moisture from entering the unit.

**NOTICE: Tag the unit with a warning that it is pressurized.**

3. If a purge gas is not available, fog oil into the compressor suction while rotating the unit. Then plug all openings to keep out moisture, insects, etc.

4. Turn the flywheel by hand a few revolutions once a month to distribute the oil.

5. Store the unit under a plastic wrap on its wooden shipping base up off the ground. If the unit was boxed for export shipment, leave it in its box. An indoor or covered storage area is preferable.

6. When the compressor is to be put in service, vent the remaining purge gas and change the crankcase oil. See the "Pre-Startup Checklist" and "Startup Procedure" sections in this manual.

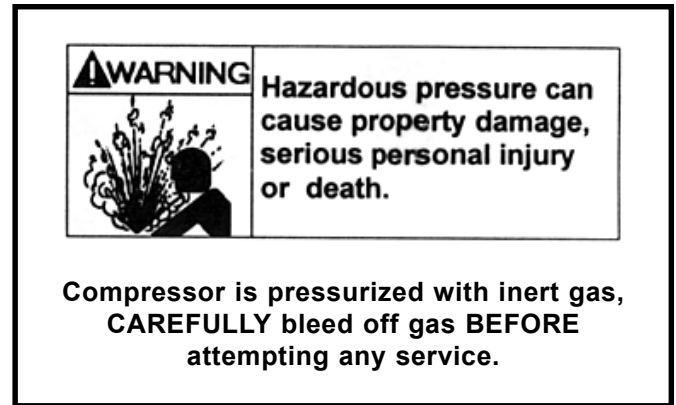


Figure 16 - Pressurized Compressor Tag

## TROUBLESHOOTING

PROBLEM	STEP	PROBABLE CAUSE	WHAT TO CHECK	IF PROBLEM EXIST STILL GO TO STEPS ...
Low Transfer Rate	1	4-Way Valve Leaking (when equipped)	Lubricate with a stick lubricant compatible with material being transferred.	2
	2	Worn or Broken Piston Rings	Check condition of rings by restricting discharge line. If pressure increases slowly, rings are probably faulty.	3
	3	Plugged Strainer	Clean screen as necessary.	4
	4	Compressor Valve Faulty	Remove and inspect for broken or worn springs, discs, or bodies.	5
	5	Liquid Relief Valves Need Adjusting	Adjust per instructions in "Valve Replacement."	6
	6	Compressor Drive Slipping	Tighten belts, check for sheared keys, loose keys or loose flywheel.	7
	7	Piping Improperly Designed or Installed	Use proper pipe sizes.	8
No Flow	8	Liquid Trap Full	Drain liquid trap through drain valve. Relieve vacuum through bleeder valve on top of liquid trap.	9
	9	Excess Flow Valves Slugged	Stop the compressor to let the excess flow open. Installation of a valved bypass line between the suction and discharge lines may be necessary.	6 & 7
Knocks or Other Noises	10	Loose Valves	Tighten valve hold-down screws.	11
	11	Worn Internal Parts	Inspect through inspection plates and repair as necessary.	4
No Oil Pressure	12	Oil Pump Relief Valve Not Properly Set.	Set oil pump relief valve.	13
	13	Oil Pump Not Working	Check the Oil Pump drive tab or stop pin for damage.	14
	14	Low Oil Level	Check and fill as necessary.	15
	15	Dirty Inlet Strainer	Clean Inlet Strainer.	
Gas Leaking from Crankcase Breather	16	Faulty / Worn Packing	Replace Packing.	17
	17	Piston Rod Scored	Replace crosshead assemblies and packing.	18
	18	Improper Seal Arrangement	See "Seal Arrangements."	19
Shake or Vibration	19	Improper Mounting	Ensure base is supported full length. See "Mounting the Compressor."	20
	20	Nonfunctioning Valves	Replace or repair valves.	

**Suggested Spare Parts for LB 361 B Compressors:**
**CB-5C-031**

Part #	Description		Q.ty. / Unit	Comm. Q.ty.	Spare Q.ty.
793099	Gasket Set - Buna-N, Aluminium	T	1	1	1
793259	Suction Valve Sub-Assembly	T	2		2
793279	Discharge Valve	T	2		2
793008	Piston Ring	T	6	6	6
793012	Piston Ring Expander	T	6	6	6
793499	Packing Set	T	2	2	2
794726	Oil Filter *		1		6
793004	Wrist Pin	I	2		2
793003	Wrist Pin Bushing	I	2	2	2
793002	Conrod Bearing	I	2	2	2
<b>The following parts would normally be required only for major compressor overhaul.</b>					
793029	Crosshead Assembly	I	2		1
793142	Bearing Cone		2		2
793126	Bearing Cup		2		2
793009	Conrod Assembly		2		1
793157 793191	Crankshaft Assembly with Bearing Cones Extended Crankshaft Assembly *		1		
793133	Bearing Adjustment Shim Kit		1		
794760	Oil Pump Repair Kit		1		
793045	Cylinder		1		
<b>The Following Spare Parts Kits Are Available</b>					
793229	Top end Kit (Includes 'T' Parts)				
793230	Intermediate Kit (Includes 'T' and 'I' Parts)				

\* Optional Equipment on New Compressors

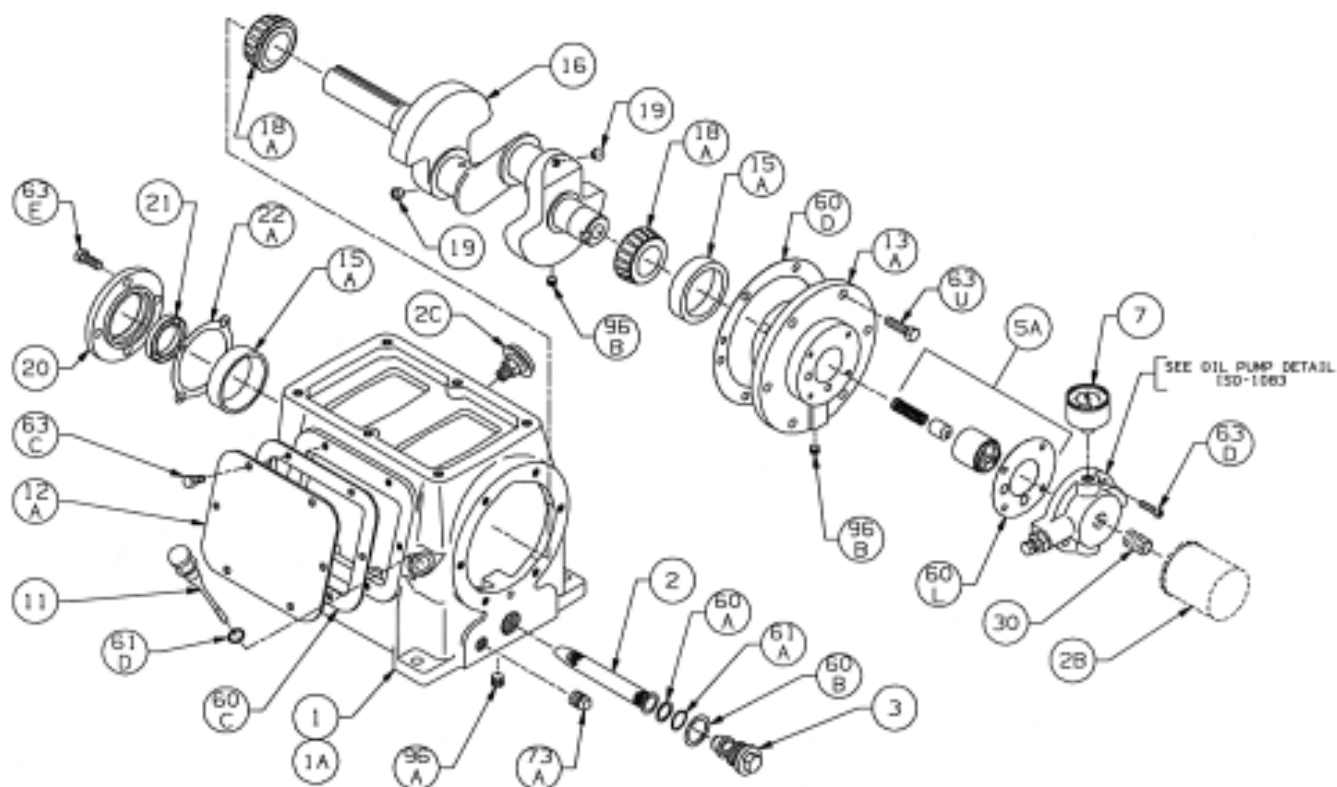
**LB 361 B PARTS LIST**
**CB-5E-031**

SERIAL # \_\_\_\_\_

ID # \_\_\_\_\_

<b>Gasket Set, Repair Kits and Special Tools</b>			<b>Bulletins Needed For Complete Parts List</b>	
Gasket Set	Buna-N & Aluminium	793099	This page .....	5E-031
Top End Repair Kit		793229	Crankcase .....	5F-021
Includes Piston Rings & Expanders, Packing Sets, Valves, Gaskets & O-rings			Oil Pump .....	5G-011
Intermediate Repair Kit		793230	Flywheel .....	5H-010
Includes Top End Kit plus Wrist Pins & Bushings, Connecting Rod Bearings, and Crossheads.			Crosshead .....	5J-030
Packing Installation Tool		790536	Head .....	5M-020
Spanner wrench, 1/4" Adjustable		790316		
Tool Kit		790199		



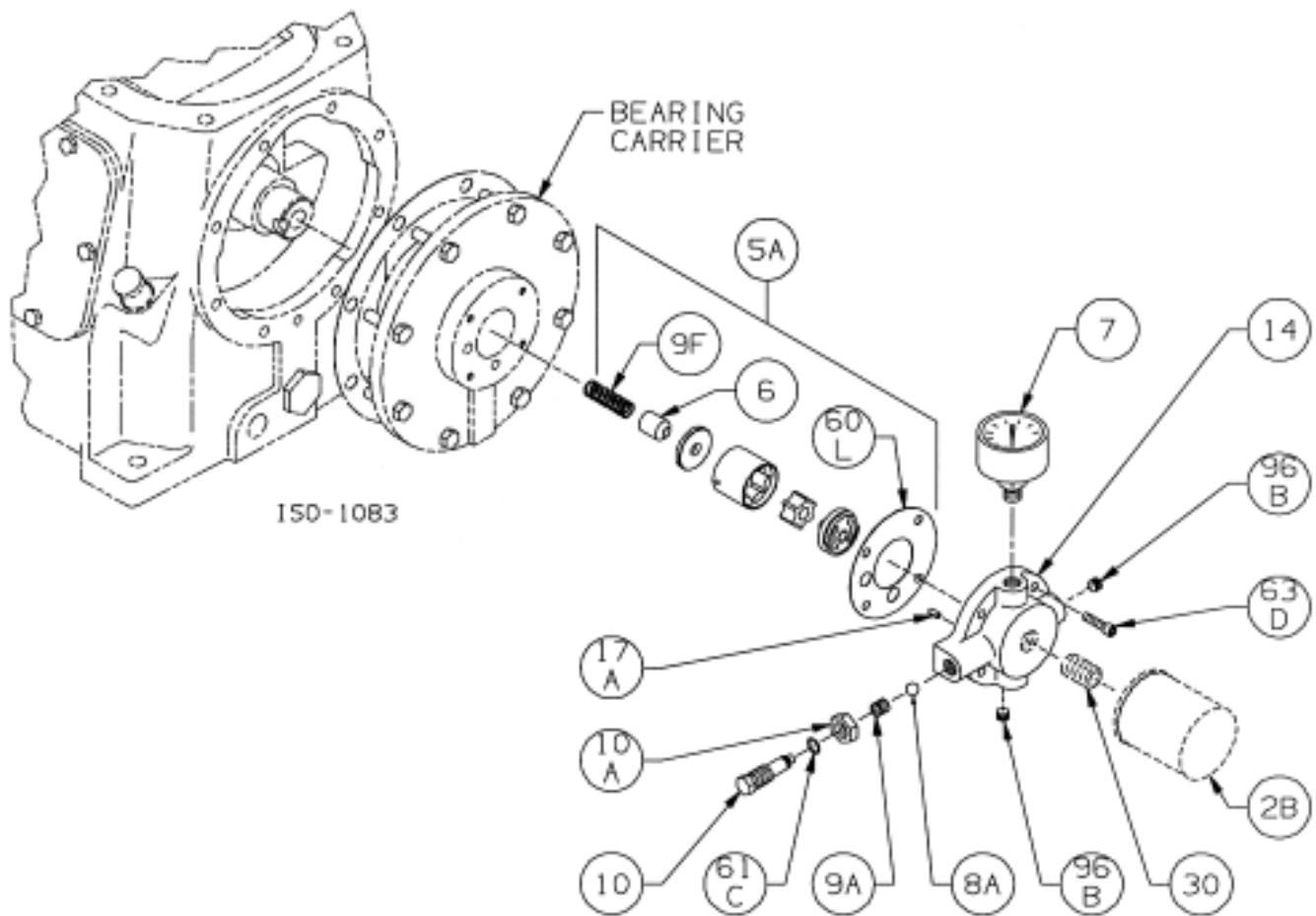


**Crankcase Assembly: Models LB 361 B, LB 362 C**

Ref.	Description	Q.ty	Part No
1	Crankcase Assembly - Std Crankcase Assembly - w\Oil Filter Crankcase Assembly - w\Ext Shaft Crankcase Assembly - w\Ext Shaft & Oil Filter	1	793103 793100 793155 793171
1A	Crankcase	1	793102
2	Oil Intake Screen	1	792135
2B	Oil Filter	1	794726
2C	Breather Filter	1	792070
3	Oil Screen Plug	1	792145
5A	Oil Pump Kit	1	794760
7	Oil Pressure Gauge	1	790012
11	Oil Bayonet Assembly	1	792162
12A	Inspection Plate	1	793105
13A	Bearing Carrier	1	793104
15A	Bearing Cup	2	793126
16	Crankshaft Assembly (w \ 18A, 19, 96B) Crankshaft Assembly-Ext (w \ 18A, 19, 96B)	1	793157 793191
18A	Bearing Cone	2	793142
19	Orifice	2	792146

Ref.	Description	Q.ty	Part No
20	Bearing Cover Plate	1	793106
21	Oil Seal	1	793143
22A	Bearing Adjustment Shim Kit	1	793133
30	Oil Filter Fitting	1	794725
60A	Gasket - Oil Screen *	1	792136
60B	Gasket - Oil Screen Plug *	1	792123
60C	Gasket - Inspection Plate *	1	793122
60D	Gasket - Bearing Carrier Assembly *	1	793124
60L	Gasket - Oil Pump Cover *	1	794721
61A	O-ring - Oil Screen *	1	792175
61D	O-ring - Oil Bayonet *	1	792174
63C	Capscrew - Hex Hd	6	793116
63D	Capscrew - Soc Hd	4	790559
63E	Capscrew - Hex Hd	4	792093
63U	Capscrew - Hex Hd	6	792093
73A	Pipe Plug	1	792166
96A	Pipe Plug	1	790488
96B	Pipe Plug	2	790309

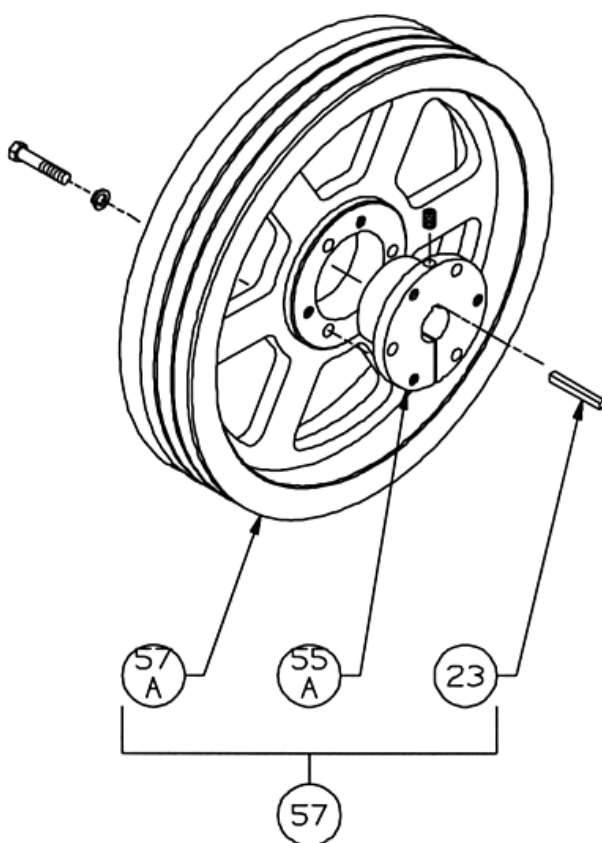
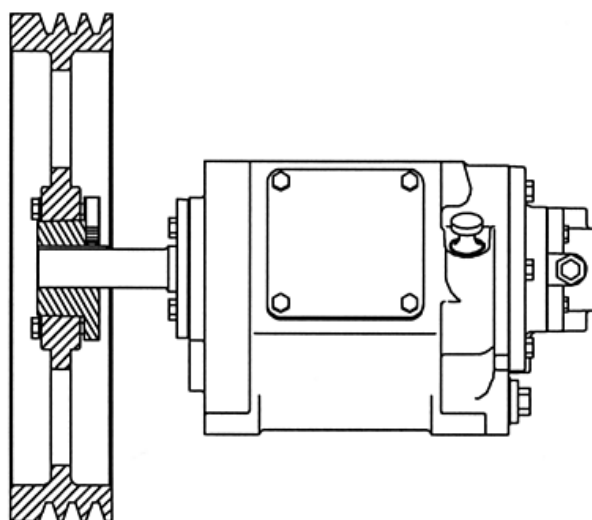
\* Included in Gasket Sets.


**Oil Pump Detail:**
**Models LB 161 B, LB 162 B, LB 361 B, LB 362 C, LB 601 B, LB 602 B, LB 942 A**

Ref.	Description	Q.ty	Part No
2B	Oil Filter	1	794726
5A	Oil Pump Kit (w/6, 9F, 60L)		794760
6	Oil Pump Cone	1	794750
7	Oil Pressure Gauge	1	790012
8A	Oil Pressure Adjusting Ball	1	792154
9A	Oil Pressure Adjusting Spring	1	792153
9F	Oil Pump Spring	1	794751
10	Oil Pressure Adjusting Screw	1	792148
10A	Locknut	1	792152

Ref.	Description	Q.ty	Part No
14	Oil Pump Cover Assembly (w/17A, 96B) Oil Pump Cover Assembly For Filter (w/17A, 96B)	1	794763 794764
17A	Roll Pin	1	794753
30	Oil Filter Fitting	1	794725
60L	Gasket - Oil Pump Cover *	1	794721
61C	O-Ring - Adjusting Screw *	1	792168
63D	Capscrew - Soc. Hd	4	790559
96B	Pipe Plug	2	790309

\* Included in Gasket Sets.

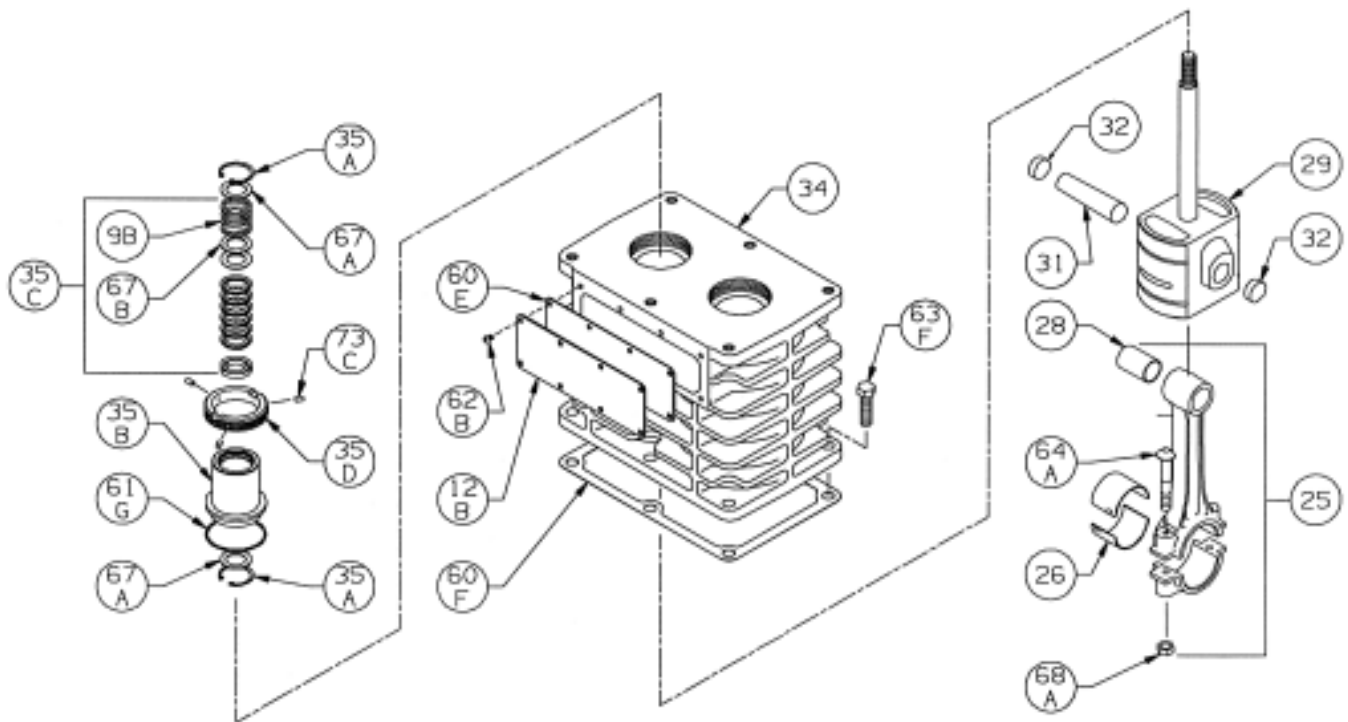


**Flywheel Assembly:  
Models LB 161 B, LB 162 B**

Ref.	Description	Q.ty	Part No
23	Key	1	792167
55A	Hub	1	790563
57	Flywheel Assembly	1	792073
57A	Flywheel	1	792071

**Models LB 361 B, LB 362 C**

Ref.	Description	Q.ty	Part No
23	Key	1	793167
55A	Hub	1	790143
57	Flywheel Assembly	1	793047
57A	Flywheel	1	792071

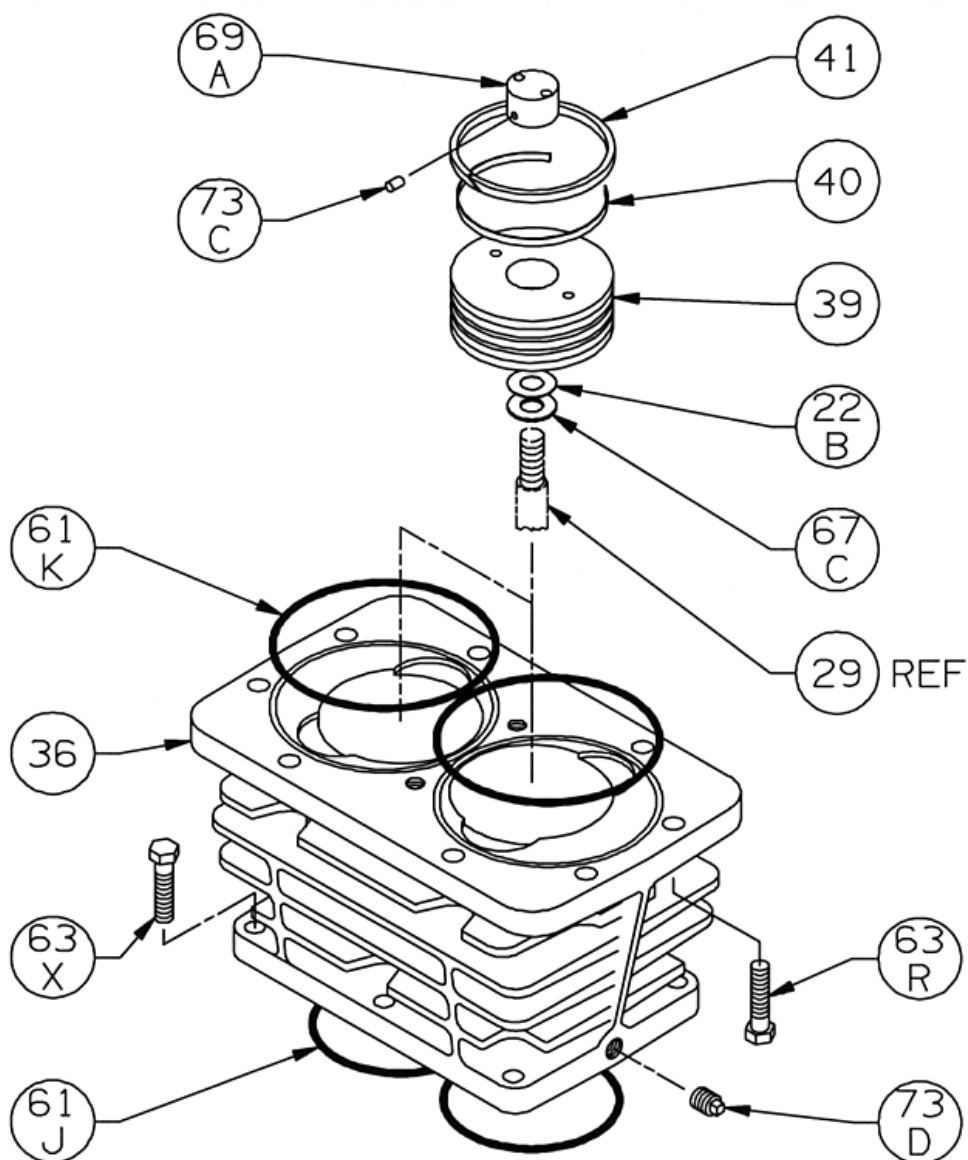


**Crosshead Assembly:  
Models LB 361 A, LB 361 B**

Ref.	Description	Q.ty	Part No
9B	Packing Spring	2	792077
12B	Inspection Plate	1	793093
25	Connecting Rod Assembly	2	793009
26	Connecting Rod Bearing	2	793002
28	Wrist Pin Bushing * *	2	793003
29	Crosshead Assembly	2	793029
31	Wrist Pin	2	793004
32	Wrist Pin Plug	4	792178
34	Crosshead Guide	1	793091
35A	Retainer Ring	4	792088
35B	Packing Box	2	793221
35C	Packing Set	2	793499

Ref.	Description	Q.ty	Part No
35D	Hold-down Ring	2	793220
60E	Gasket - Inspection Plate *	1	793092
60F	Gasket - Crankcase *	1	793121
61G	O-ring (Buna-N) Std *	2	792125
62B	Machine Screw - Inspection Plate	8	793096
63F	Capscrew - Hex Hd	6	793094
64A	Connecting Rod Bolt	4	793006
67A	Washer - Packing Box	4	792083
67B	Washer - Packing Spring	2	792087
68A	Connecting Rod Bolt Nut	4	793007
73C	Lock Plug *	6	792030

\* Included in Gasket Sets  
\* \* Must be honed after installing



**Crosshead Assembly:  
Models LB 361 A, LB 361 B, LB 362 B, LB 362 C**

Ref.	Description	Q.ty	Part No
22B	Piston Shim - 0.015 Piston Shim - 0.007	AR AR	792034 792050
36	Cylinder	1	793045
39	Piston	2	793021
40	Expander	6	793012
41	Piston Ring	6	793008
61J	O-Ring *	2	793177
61K	O-Ring *	2	793641
63R	Capscrew - Hex Hd	8	794097
63X	Capscrew - Hex Hd	6	794096
67C	Thrust Washer	2	792033
69A	Piston Nut	2	793022
73C	Lock Plug *	4	793028
73D	Pipe Plug *	1	793498

\* Included in Gasket Sets

# ISO 9000 CERTIFICATE OF COMPLIANCE

This is to certify that the Quality Management System of:

**BLACKMER, A DOVER RESOURCES COMPANY**  
1101 SOUTH PORTLAND AVE.  
OKLAHOMA CITY, OK 73108

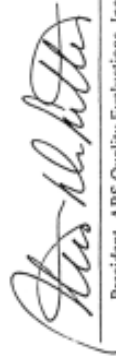
has been assessed by ABS Quality Evaluations, Inc. and found to be in compliance with the following quality standards:

**ISO 9001**

The Quality Management System is applicable to:

**DESIGN AND MANUFACTURE OF OIL-FREE GAS COMPRESSORS**

Certificate No.: 31062  
Effective Date: 7 March 1995  
Expiration Date: 6 March 2001  
Rev. No./Date: 01/3 February 1998

  
President, ABS Quality Evaluations, Inc.

President, ABS Quality Evaluations, Inc.



Accredited by  
the Dutch Council  
for Certification



**Validity of this certificate is based on periodic audits of the management system defined by the above scope and is contingent upon prompt, written notification to ABS Quality Evaluations, Inc. of significant changes to the management system or components thereof.**

ABS Quality Evaluations, Inc. 16855 Northchase Drive, Houston, Texas 77060 U.S.A.



**DESIGN, SALE & INSTALLATION OF L.P.G. - NATURAL GAS SYSTEMS**

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